

Summary Report on the First General Meeting of the International Committee on Irradiated Concrete

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Prepared by

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Summary Report on the First General Meeting of the International Committee on Irradiated Concrete

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1. Executive Summary:

This report provides a summary of the First General Meeting (FGM) of the International Committee on Irradiated Concrete (ICIC), which was held November 2 -5, 2015, at the Knoxville Hilton Hotel in Knoxville, USA. The FGM of the ICIC was based on the platform established at the first and second ICIC Information Exchange Framework meetings held in Barcelona and Helsinki in March and October of 2014, respectively. Those meetings focused on developing a technical organization whose goal would be to exchange information on a broad set of topics related to the effects of irradiation on concrete used in nuclear power applications and providing a forum for discussing issues that advance the state of knowledge of the effects of irradiation on structural concrete.

The purpose of the Knoxville ICIC FGM was four-fold. Firstly, to provide a forum for timely information exchanges among organizations pursuing the identification, quantification, and modeling of the effects of radiation on concrete in commercial nuclear applications. Specifically, determinations of the effects of radiation damage as reflected by changes in engineering properties. Secondly, to promote broad application of highly specialized or unique investigation techniques to relevant research materials of wide interest to develop improved understanding and predictions of the effects of radiation on concrete, cementitious composites, and its constituents. Thirdly, to facilitate the conception, planning and guidance of new cooperative research programs, for example: facilitating the collection (harvesting) and distribution of pedigreed materials suitable for concrete irradiation damage investigations. And finally, to promote cross-institutional utilization of resources, where possible, that reflect mutual research interests or needs.

Thirty-two attendees from 18 organizations and 8 countries participated the First General Meeting of the International Committee on Irradiated Concrete in Knoxville, USA, on 2-5 November 2015. Oak Ridge National Laboratory (ORNL) hosted the meeting, which was organized and chaired by Dr. Rosseel, with support from the US Department of Energy, Light Water Reactor Sustainability (LWRS) Program and the Electric Power Research Institute (EPRI).

The ICIC FGM Agenda, list of participants, and the ICIC Charter are included at the end of the report.

2. Background:

Understanding the effects of radiation on concrete is important in determining long-term or extended operating performance of concrete structures in existing nuclear power plants (NPPs). Not surprisingly, this issue is being addressed by research organizations and utilities across the globe. In the last twenty months, the Materials Aging and Degradation Pathway has been actively working to build international partnerships and collaborations in an effort to better define the issues, develop a sound approach to resolving the major questions, and maximizing resources.

For example, multiple discussions beginning in June 2012 were held with Japanese research organizations participating in the Japan Aging Management Program for Systems and Structures (JAMPSS). The focus was on opportunities to review data from gamma irradiation studies of prototypical concrete, providing suggestions for additional neutron irradiation experiments underway at the Halden Reactor Project, Institute for Energy Technology, JEEP-2 reactor facility, and developing a better understanding of the effects of radiation on concrete degradation. In June 2013, discussions were initiated with VTT Technical Research Center and Fortum Corporation in Helsinki. The focus was on opportunities to share resources and data, as well as to participate in an international effort to evaluate the potential for radiation-induced degradation, and to develop a better understanding of the effects of radiation on structural concrete. Finally, discussions also were initiated in June 2013 with the Research Centre Rez, Czech Republic, concerning opportunities to perform accelerated neutron studies at the LVR-15 reactor and post irradiation evaluation (PIE) at the Czech Technical University in Prague in collaboration with the Electric Power Research Institute (EPRI).

The foundation for the ICIC has been the understanding that international cooperation will provide the best opportunities to share resources, acquire valuable specimens from decommissioned nuclear power plants, and build a systematic database to provide a framework for decisions concerning extended operation of nuclear power plants in a timely and efficient manner.

Barcelona Meeting: Dr. Rosseel organized and chaired the International Irradiated Concrete Information Exchange Framework Meeting in Barcelona, Spain, on March 12-14, 2014. Nineteen researchers from five countries attended the meeting, which was held at the Hotel Colon. Representatives from four other countries expressed strong interest in participating but due to conflicts were unable to send representatives. The local host for the meeting was Professor Carmen Andrade, Consejo Superior de Investigaciones Científicas – CSIC (Spanish National Research Council).

The purpose of this meeting was two-fold. First, to develop the framework for exchanging information on a broad set of topics related to the effects of irradiation on concrete used in NPPs by those who are actively pursuing research, were active in the field, or wish to contribute to advancing the current state of knowledge. And second, to provide a forum for discussing issues that advance the state of knowledge of the effects of irradiation on structural concrete used in nuclear reactor facilities including storage sites.

The first portion of the meeting included presentations and discussions on past and current irradiated concrete research and / or issues related to irradiated concrete. The second portion of the meeting focused on establishing the framework for exchanging information. This included a

discussion of the types of information that could be exchanged, the level of release, and the framework for cooperation including resource and data sharing.

The final portion of the meeting was the decision or commitment by attendees to participate in the information exchange. By agreeing to continuing discussions and interactions, the participants have tentatively agreed to the establishment of a new organization and a plan to determine the frequency and location of future International Committee on Irradiated Concrete meetings. It is anticipated that future meetings will be held on a rotating schedule in Europe, the US, and Japan.

Presentations on the latest results of neutron and gamma irradiation experiments, including unexpected experimental difficulties, proposed irradiation experiments, the re-evaluation of past irradiation data and model to address first order affects, and numerical simulations were given and discussed. Moreover, a draft charter for a new international organization, the International Committee on Irradiated Concrete (ICIC), based on the International Group on Radiation Damage Mechanisms (IGRDM) in reactor pressure vessels, was proposed and vigorously discussed. The draft charter identified the objectives of the organization, membership requirements and obligations, organizational structure, topics for technical discussions, dissemination of public and member information, and meeting format and frequency. At the conclusion of the meeting, the participants reached a consensus to move forward with the new organization and that a follow-up meeting should be held within six months to finalize the charter. The participants elected Dr. Rosseel, Acting Chair, and Dr. Carlos Castelao, Consejo de Seguridad Nuclear, (CSN), Acting Vice Chair, to lead the interim process.

Helsinki Meeting: Twenty-five attendees from 18 organizations and 7 countries attended the second International Committee on Irradiated Concrete (ICIC) Information Exchange Framework Meeting in Helsinki, Finland, on 8 – 10 October 2014. The purpose of the meeting, which was organized and chaired by Dr. Rosseel and graciously hosted by the Fortum Corporation, was two-fold. First, to finalize the framework established at the first ICIC framework meeting in Barcelona for developing a technical organization whose goal is to exchange information on a broad set of topics related to the effects of irradiation on concrete used in nuclear power applications. And second, to provide a forum for broad technical interactions in research on the effects of irradiation on concrete used in nuclear applications, such as nuclear facilities, storage, and disposal sites, and which will contribute to advancing the current state of knowledge.

Twenty-three technical papers on the latest results of neutron and gamma irradiation experiments, plans for harvesting service irradiated concrete, proposed irradiation experiments, modeling of past irradiation data that address first order affects, and numerical simulations were presented and vigorously discussed. On Thursday morning, the attendees visited Aalto University, Espoo, where Professor Jari Puttonen and his colleagues provided an introduction to concrete research in the Department of Civil and Structural Engineering and a tour of the concrete research laboratory.

At the conclusion of the meeting, the participants approved the revised ICIC Charter with 19 of the participants and 16 organizations accepting membership in the duly constituted International Committee on Irradiated Concrete. The participants also selected four Technical Areas (TA) and corresponding Technical Area Coordinators (TAC). The main function of the TA and TAC is to facilitate and expedite progress by the membership in specified technical topics. The four TA and TAC selected by vote of the members are as follows:

1. Structural Performance & Mechanistic Understanding of the Effects of Irradiation on Concrete (Yann Le Pape – ORNL, USA)
2. Harvesting and Characterization of Service Irradiated Concrete (Manuel Ordonez, ENRESA, Spain)
3. Accelerated Irradiation Studies of Concrete and Its Components (Michal Koleska, RC-Rez, Czech Republic)
4. Characterization of Irradiated Concrete (Carmen Andrade, CSIC, Spain)

Finally the participants elected Dr. Rosseel, ORNL, as Chairman, Prof. Maruyama, Nagoya University, as Vice Chairman, and Dr. Miguel Ferreira, VTT, as Secretary of the ICIC. It was anticipated that the first General Meeting of the ICIC would be held in the US in late October 2015.

3. Purpose and Goals:

The purpose of the Knoxville FGM, which was hosted by ORNL at the Knoxville Hilton, was four-fold. The first and primary focus of the meeting was to provide a forum for timely information exchanges among organizations pursuing the identification, quantification, and modeling of the effects of radiation on concrete in commercial nuclear applications. Specifically, determinations of the effects of radiation damage as reflected by changes in engineering properties. The forum's technical sessions were developed based on Technical Area Coordinator's vision of how to best highlight and enhance progress in the member-selected Technical Areas as described in the ICIC Charter. Secondly, to promote broad application of highly specialized or unique investigation techniques to relevant research materials of wide interest to develop improved understanding and predictions of the effects of radiation on concrete, cementitious composites, and its constituents. Thirdly, to facilitate the conception, planning and guidance of new cooperative research programs, for example: facilitating the collection (harvesting) and distribution of pedigreed materials suitable for concrete irradiation damage investigations. And finally, to promote cross-institutional utilization of resources, where possible, that reflect mutual research interests or needs.

4. Meeting Summary:

Thirty-two attendees from 18 organizations and 8 countries participated the First General Meeting (FGM) of the International Committee on Irradiated Concrete (ICIC) in Knoxville, USA, on 2-5 November 2015. ORNL hosted the meeting, which was organized and chaired by Dr. T. M. Rosseel, with support from the US Department of Energy, Light Water Reactor Sustainability (LWRS) Program and the Electric Power Research Institute (EPRI). The Knoxville ICI FGM was based on the platform established at the first and second ICIC framework meetings in Barcelona and Helsinki that developed a technical organization whose goal would be to exchange information on a broad set of topics related to the effects of irradiation on concrete used in nuclear power applications.

The meeting was organized around Four Technical Sessions:

- **Structural Performance and Mechanistic Understanding of the Effects of Irradiation on Concrete** (Session Co-Chairs: Y. Le Pape – ORNL, USA and I. Maruyama, Nagoya University, Japan)

- **Irradiated Concrete Research Programs** (Session Chair: T. M. Rosseel, ORNL, USA)
- **Accelerated Irradiation Studies of Concrete and Its Components** (Session Co-Chairs: M. Ferreira, VTT, Finland and O. Kontani, Kajima, Corporation, Japan)
- **Characterization of Irradiated Concrete and Harvesting and Characterization of Service Irradiated Concrete** (Session Co-Chairs: M. Ordonez, ENRESA, Spain and T. M. Rosseel, ORNL, USA)

Twenty-nine technical papers and two posters on the latest results of neutron and gamma irradiation experiments, plans for harvesting service irradiated concrete, proposed irradiation experiments, modeling of past irradiation data that address first order effects, and numerical simulations were presented and vigorously discussed. Moreover, the presentations included a summary discussion (Rosseel) of the formation of the ICIC from the Barcelona and Helsinki information exchange meetings, an overview of materials research and capabilities at ORNL (Busby), and an overview of the LWRs Program Materials Pathway (Leonard).

The Structural Performance and Mechanistic Understanding of the Effects of Irradiation on Concrete Session (Session Co-Chairs: Y. Le Pape – ORNL, USA and I. Maruyama, Nagoya University, Japan), which accounted for 40% of the technical presentations began on Tuesday with a summary of the Helsinki meeting by Y. Le Pape, ORNL, followed by a presentation by Igor Remec, ORNL, on developing a unified parameter for characterizing radiation that results in the concrete degradation. I. Pignatelli, University of California at Los Angeles (UCLA), discussed recent experiments that demonstrated differing reactivity of calcite and quartz following irradiation. This was followed by a joint ORNL / Czech Technical University (CTU) presentation on meso-scale modeling of concrete irradiated in a test reactor by A. Giorla, ORNL, and M. Vaitová, CTU and another presentation by A. Giorla, ORNL, discussing preliminary results on the effects of creep and structural restraint on radiation-induced degradation.

G. Sant, UCLA, outlined a new Nuclear Energy University Partnership (NEUP) project in collaboration with Arizona State University (ASU) on the effects of neutron radiation on aggregate-induced concrete degradation. This was followed by a presentation on the effects of gamma radiolysis in cementitious materials by P. Bouniol, Commissariat à l’Energie Atomique (CEA). I. Maruyama, Nagoya University (NU), discussed numerical methods to evaluate stress-strain behavior of concrete aggregate expansion using rigid body spring networks and was followed by a presentation on the combined effect of temperature and radiation on concrete expansion by Y. Le Pape, ORNL, in collaboration with Electricité de France (EdF).

In collaboration with Kajima Corp (KC) and Mitsubishi Research Institute (MRI), I. Maruyama, NU, discussed a numerical model for predicting the effects of radiation on the properties of massive concrete structures. This was followed by a presentation on an initial 2-D model of Pressurized Water Reactor (PWR) vessel supports by J. Wall, EPRI and a presentation by Y. Le Pape, ORNL, on the structural significance of radiation for PWR concrete biological shield integrity. The session concluded with a presentation by Y. Le Pape, on behalf of B. Pomaro, University of Padova, on a combined FEM-Monte Carlo approach to assess the effects of radiation concrete shielding.

The final session of the first day, *Irradiated Concrete Research Programs* (Session Chair: T. Rosseel, ORNL) focused on the programmatic goals of the Japan Aging Management Program for Systems and Structures (JAMPSS) and the US Nuclear Regulatory Commission. M. Takizawa, MRI, discussed the R&D roadmap for LWR safety in Japan and the current JAMPSS schedule. This was followed by a presentation on the NRC's perspective on radiation effects on concrete structures and a call for greater collaboration by M. Sircar.

On Wednesday morning, the attendees traveled to ORNL for tours of the Low Activation Materials Design and Analysis (LAMDA) facility and the High Flux Isotope Reactor (HFIR). The LAMDA tour focused on the physical and mechanical properties tools available for characterizing irradiated concrete and its components. The HFIR tour focused on the materials irradiation and Small Angle Neutron Scattering (SANS) characterization capabilities available for studying the effects of radiation on concrete. Coincidentally, the visit occurred on the seventy-second anniversary of the historic ORNL Graphite Reactor reaching criticality. It was the first reactor to achieve criticality following the work at the University of Chicago Pile experiment.

On Wednesday afternoon, the *Accelerated Irradiation Studies of Concrete and Its Components* Technical Session (Session Co-Chairs: M. Ferreira, VTT, Finland and O. Kontani, Kajima, Corporation, Japan), began with a presentation by J-H Hansen, Institute for Energy Technology (IFE) describing the irradiation and testing of concrete at the IFE facility in Kjeller, Norway. This facility is currently used by two ICIC organizations due to the combination of flux high enough to complete experiments in one to two years but low enough to limit the thermal gradient problems of gamma heating. This was followed by presentations on the latest JAMPSS gamma-ray experiments results by O. Kontani, KC, and the JAMPSS Neutron Irradiation Experiment by S. Ishikawa, KC, in collaboration with NU and MRI. R. Korhonen, Fortum, discussed recent results from irradiation studies of Loviisa NPP concrete structures followed by a presentation by T. Cernousek, Research Center, Rez, on the possible use of geo-polymers in combination with concrete to minimize radiation effects. The session concluded with a presentation by T. Rosseel, ORNL, on the effects of fluence and temperature on single crystal analogues of concrete aggregates.

At the conclusion of the *Accelerated Irradiation Studies of Concrete and Its Components* Technical Session, the ICIC Executive Committee (Officers and Technical Area Coordinators) announced the addition of nine new members and previewed the issues to be discussed at the ICIC business meeting. Moreover, on Thursday morning during the ICIC business meeting, the ICIC Principal Contacts approved the Executive Committee's proposal to combine two Technical Areas (TA): *Characterization of Irradiated Concrete* and *Harvesting and Characterization of Service Irradiated Concrete* into a single TA: *Characterization of Irradiated Concrete and Concrete Components* with Dr. M. Ordonez as the TAC. Moreover, a new technical area, "*Long term reliability of concrete in irradiation environments (HLW Storage / Disposal Issues)*" was created with Dr. M. Ferreira (VTT) as the TAC. Furthermore, Prof. Maruyama, NU, was elevated to the position of Chairman, replacing Dr. Rosseel, whose term ended at the conclusion of the meeting. With the approval of the Principal Contacts, Dr. Rosseel was appointed as Past Chairman and Dr. Y. Le Pape, ORNL, was elected Vice Chairman. Dr. Miguel Ferreira, VTT, will continue as the ICIC Secretary. The new ICIC Chairman, Professor Maruyama, announced that the Second General Meeting (SGM) of the ICIC would be held in Japan in late October or early November 2016.

Following the ICIC business meeting, the final session, *Characterization of Irradiated Concrete and Harvesting and Characterization of Service Irradiated Concrete* (M. Ordonez, ENRESA, Spain and T. Rosseel, ORNL, USA) began with a presentation by H. Wada, Chubu Electric Power Company (CEPCO), in collaboration with KC and NU, on concrete harvesting opportunities from the Hamaoka-1 NPP. This was followed by an invited presentation on non-destructive examination of (NDE) of thick concrete using advanced signal processing techniques by D. Clayton, ORNL. Although this invited presentation was not specifically concerned with irradiation effects, the ICIC Chairman noted that the topic would provide insight and information applicable to irradiated concrete research. On behalf of the Zorita Technical Committee, M. Ordonez, ENRESA, presented talks on the status of the Zorita NPP concrete harvesting, including an analysis of the radiation dose and temperature, and the composition of the Zorita concrete biological shield. The session concluded with a presentation by T. Rosseel, ORNL, on the Zion NPP: Concrete Harvesting Status.

The ICIC FGM concluded with Technical Area summary presentations and discussions on the major research advances and issues that need to be addressed led by the Technical Area Coordinators and Session Co-Chairs.



Some of the participants of the First General Meeting of the International Committee on Irradiated Concrete
(Wednesday, 4 November 2015)



Some of the participants of the First General Meeting of the ICIC receive a briefing on the operation and history of the ORNL High Flux Isotope Reactor. The visit on Wednesday, 4 November 2015, was the seventy-second anniversary of the historic ORNL Graphite Reactor reaching criticality. The ORNL Graphite Reactor was the first reactor to achieve criticality following the work at the University of Chicago Pile.

**International Committee on Irradiated Concrete (ICIC) First General Meeting AGENDA
2 – 5 November 2015
Hilton Hotel
Knoxville, Tennessee, USA**

Monday, 2 November 2015

15:30 – 19:30 Meeting Check-in, Salon A

16:00 Executive Committee Meeting (ICIC Officers and Technical Area Coordinators), Board Room

Chairman: Dr. Thomas M. Rosseel, Oak Ridge National Laboratory, USA
Vice Chairman: Professor Ippei Maruyama, Nagoya University, Japan
Secretary: Dr. Miguel Ferreira, VTT, Finland

Technical Areas and Technical Area Coordinators:

Structural Performance and Mechanistic Understanding of the Effects of Irradiation on Concrete (Y. Le Pape – ORNL, USA)

Accelerated Irradiation Studies of Concrete and Its Components (Dr. M. Koleska, CV- Rez, Czech Republic)

Characterization of Irradiated Concrete (Dr. C. Andrade, CSIC, Spain)

Harvesting and Characterization of Service Irradiated Concrete (Dr. M. Ordonez, ENRESA, Spain)

Discussion Topics:

- Nomination of Officers (Candidates)
- Future Meetings (Options)
- Membership Review (Individual, Organizational, and Principal Contacts)
- New / Revised Technical Areas (Review Options)
- Changes to the Charter (Suggestions)
- Opportunities for Collaborations
- Other Issues

18:00 Adjourn

International Committee on Irradiated Concrete (ICIC) First General Meeting AGENDA
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Tuesday, 3 November 2015 Salon A

7:15 Meeting Check in

8:15 Coffee

8:30 Welcome / Agenda / Summary of Barcelona and Helsinki Framework Meetings (**T. Rosseel**, ICIC Chair)

9:00 Introduction of ICIC Executive Committee (**All**)

9:15 Oak Ridge National Laboratory Materials R&D Overview, **Dr. Jeremy T. Busby**, Director, Materials Science and Technology Division)

Participant Presentations: Technical Area Session: Structural Performance and Mechanistic Understanding of the Effects of Irradiation on Concrete (Y. Le Pape – ORNL, USA and I. Maruyama, Nagoya University, Japan)

9:45 USA: DOE LWRS: ORNL “State of the Art: Summary of Last ICIC Meeting in Helsinki,” **Y. Le Pape**, Oak Ridge National Laboratory (ORNL).

10:15 USA: DOE LWRS: ORNL “A Unified Parameter for Characterizing Radiation in the Evaluation of Radiation-Induced Degradation of Concrete,” **I. Remec**, ORNL.

10:35 Break

11:00 USA: UCLA, ORNL “Direct Experimental Evidence for Differing Reactivity Alterations of Minerals following Irradiation: The Case of Calcite and Quartz,” I. Pignatelli (1); A. Kumar (1); K. Field (2); B. Wang, (1); Y. Yu (1); H. Dobbs (1); Y. Le Pape (2); J. Israelachvili (1); M. Bauchy (1) and **G. Sant** (1) - (1) University of California, Los Angeles (UCLA), (2) ORNL.

11:30 USA: ORNL / Czech Republic: CTU: “Meso-Scale Modeling of Irradiated Concrete in Test Reactor,” **A. Giorla (1), M. Vaitová (2)**, Y. Le Pape (1) and P. Štemberk (2) - (1) ORNL, (2) České vysoké učení technické v Praze (CTU).

12:00 Lunch, Salon B

Lunch Presentation: USA: ORNL, “Preliminary Investigation of Creep and Structural Restraint on Radiation-induced Expansion and Degradation,” **A. Giorla**, ORNL

13:10 USA: UCLA, ORNL, ASU: “The Influences of Neutron Irradiation on Aggregate Induced Degradation of Concrete – NEUP Program. I. Pignatelli (1); A. Kumar (1); K. Field (2); Y. Le Pape (2); M. Bauchy (1); **G. Sant** (1) and Neithalath, N. (3) – (1) UCLA, (2) ORNL, (3) Arizona State University (ASU), USA.

13:50 France: CEA: “Radiolysis Effects in Cementitious Materials,” **P. Bouniol**, B. Bary, and V. L’Hostis, Commissariat à l’Energie Atomique (CEA).

14:20 Japan: Nagoya University: “Numerical Evaluation of Stress-Strain Behavior of Concrete Cylindrical Specimens Containing Expansive Aggregates Using Rigid Body Spring Network (RBSN),” **I. Maruyama**, and K. Ogawa, Nagoya University.

14:50 USA: LWRS, ORNL / France: EdF: “On the Combined Effect of Temperature and Irradiation on Concrete Expansion and Mechanical Properties,” **Y. Le Pape (1), A. Giorla (1)**, K. G. Field, (1) and J. Sanahuja, J. (2). – (1) ORNL, (2) Electricité de France (EdF).

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Tuesday, 3 November 2015, Salon A/B

15:20 Break

15:50 Japan: JAMPSS: Nagoya University, “Numerical Model for Predicting Concrete Properties in Massive Concrete under Irradiation,” **I. Maruyama (1)**, K. Haba (4), O. Sato (2), Dr. M. Takizawa (3), Dr. O. Kontani (2), and Mr. Y. Ishikawa (2) – (1) Nagoya University, (2) Kajima Corp., (3) Mitsubishi Research Institute, (4) Mitsubishi Research Associates, Japan

16:20 USA: EPRI: “First Pass 2-D Model of PWR Vessel Supports,” **J. Wall**, Electric Power Research Institute, USA

16:40 USA: ORNL, “Structural Significance of Irradiation for Pressurized Water Reactors (PWRs) Concrete Biological Shield Integrity,” **Y. Le Pape**, ORNL

17:00 Italy: University of Padova, “A combined FEM-Monte Carlo approach to assess damage effects on irradiated concrete,” B. Pomaro (1); B., C. Majorana (1); Valentina Salomoni (1), Fabiana Gramegna (2), Gianfranco Prete (2). – (1) Università degli Studi di Padova., (2) National Institute of Nuclear Physics (INFN) Presented by **Y. Le Pape**, ORNL

Participant Presentations: Irradiated Concrete Research Programs (T. Rosseel)

17:20 Japan: JAMPSS: “R&D Roadmap for LWR Safety in Japan and the Latest Schedule on JAMPSS,” **M. Takizawa**, Mitsubishi Research Institute, Japan

17:40 USA: NRC: “NRC’s Perspective on Radiation Effects on Concrete Structures,” **M. Sircar**, US Nuclear Regulatory Committee

18:00 First Day Summary and Discussion (Le Pape, Maruyama, Rosseel, All)

18:15 Adjourn

Poster Sessions: Salon A

Tuesday: 8:00 – 18:00

Wednesday: 13:00 – 17:00

Thursday: 9:00 – 15:00

K. Field, ORNL, “Evaluation of Irradiated Concrete Performance for Long Term Operation of Nuclear Power Plants.”

A. Giorla, ORNL and C. Dunant, École Polytechnique Fédérale de Lausanne (EPFL), “Automated Mechanics Integrated Environment (AIME).”

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Wednesday, 4 November 2015

07:45 Travel to Oak Ridge National Laboratory by bus from Hilton Hotel (Meet in Lobby)

09:00 Tour of Low Activation Materials Design and Analysis (LAMDA) Facility, Building 4508, Lobby

10:00 Travel to the High Flux Isotope Reactor (HFIR) (<http://neutrons.ornl.gov/hfir>), (Passports / Photo ID)

10:15 HFIR Tour

11:15 Depart HFIR/ ORNL for Knoxville, Hilton Hotel (Box lunches provided on return trip)

Salon A/B: Participant Presentations: Technical Area Session: Accelerated Irradiation Studies of Concrete and Its Components (M. Ferreira, VTT, Finland and O. Kontani, Kajima, Corporation, Japan)

13:00 Announcements

13:10 Norway: IFE: "Irradiation and Testing of Concrete at IFE, **J-H Hansen**, Institute for Energy Technology.

13:30 Japan: JAMPSS: Kajima Corp, "Update on JAMPSS Gamma-ray Irradiation Experiments," **O. Kontani** (1), S. Sawada (1), J. Yasukoch (1), S. Ishikawa (1), I. Maruyama (2), M. Takizawa (3) and O. Sato (3) – (1) Kajima Corp., (2) Nagoya University, (3) Mitsubishi Research Institute.

14:00 Japan: JAMPSS: Kajima Corp: "Update on JAMPSS Neutron Irradiation Experiment, **S. Ishikawa** (1), O. Kontani (1), S. Sawada (1), J. Yasukoch (1), I. Maruyama(2), M. Takizawa(3) and O. Sato(3) – (1) Kajima Corp., (2) Nagoya University, (3) Mitsubishi Research Institute.

14:30 Finland: Fortum: "Recent Progress in Irradiation Effect Studies on Concrete Structures at the Loviisa NPP," **R. Korhonen** and T. Eurojoki,

15:00 Break:

15:30 Czech Republic: UJV/CVRez: "Irradiation and Testing Infrastructure of UJV and Research Center Řež for Lifetime Management of NPP Concrete Structures," **T. Cernousek** / M. Koleska

16:00 US: DOE LWRS: ORNL, "Single Variable Study of the Effects of Radiation on Single Crystal Mineral Analogues of Concrete Aggregates," **T. Rosseel**, K. Field, Y. Le Pape, D. Erdman, L. Anovitz, and C. Silva,

16:30 Review of ICIC Issues (ICIC Executive Committee):

- Nomination of Officers
- Future Meeting Site
- Memberships (Individual, Organizational, and Principal Contacts)
- New / Revised Technical Areas
- Charter Updates
- Opportunities for Collaborations (M. Sircar)
- Other Issues

17:15 Second Day Summary and Discussion (Ferreira, Kontani, Rosseel, All)

17:30 Adjourn

18:45 Optional Evening Event: Meet in Hilton Lobby

**International Committee on Irradiated Concrete (ICIC) First General Meeting AGENDA
2 – 5 November 2015
Hilton Hotel
Knoxville, Tennessee, USA**

Thursday, 5 November 2015, Salon A

08:00 Meeting Check in

09:00 Coffee / Announcements

9:10 Discussion and vote on ICIC Issues (*ICIC Executive Committee*):

- Election of Officers
- Selection of Site for Next General Meeting
- New Individual, Organizational Members, and Principal Contacts
- New / Revised Technical Areas
- Charter Updates / Revisions
- Opportunities for Collaborations
- Other Issues

Participant Presentations: Technical Area Session: Characterization of Irradiated Concrete and Harvesting and Characterization of Service Irradiated Concrete (M. Ordonez, ENRESA, Spain and T. Rosseel, ORNL, USA)

10:10 Japan: CEPSCO: “Hamaoka-1 Project: Harvesting Opportunities,” *H. Wada* (1), O. Kontani (2), and I. Maruyama (3) – (1) Chubu Electric Power Company, (2) Kajima Corp., (3) Nagoya Univ., Japan

10:40 Break

11:10 USA: DOE LWRS: ORNL “NDE of Thick Concrete Using Advanced Signal Processing Techniques,” *D. Clayton*, ORNL, USA.

11:45 Lunch, Salon C

12:00 Lunch Presentation: USA: ORNL, “LWRS Overview and Selected Highlights” *K. Leonard, T. Rosseel, J. Busby*, ORNL

13:00 Spain: Zorita Technical Committee: “Zorita NPP Concrete Harvesting Status,” *M. Ordonez*, ENRESA, Spain

13:30 Spain: Zorita Technical Committee: “Characterization of Zorita Concrete,” *M. Ordonez*, ENRESA, Spain

14:00 USA: LWRS: ORNL, “Zion NPP: Concrete Harvesting Status,” *T. Rosseel*, ORNL, USA.

Technical Area Summary Presentations and Discussions (Technical Area Coordinators and Session Co-Chairs)

14:20 Structural Performance and Mechanistic Understanding of the Effects of Irradiation on Concrete (Y. Le Pape – ORNL, USA and I. Maruyama, Nagoya University, Japan)

14:50 Accelerated Irradiation Studies of Concrete and Its Components (M. Ferreira, VTT, Finland and O. Kontani, Kajima, Corporation, Japan)

15:10 Characterization of Irradiated Concrete and Harvesting and Characterization of Service Irradiated Concrete (M. Ordonez, ENRESA, Spain and T. M. Rosseel, ORNL, USA)

15:20 Action Items and Closing Comments (Rosseel / All)

15:30 Adjourn

**International Committee on Irradiated Concrete (ICIC) First General Meeting AGENDA
2 – 5 November 2015
Hilton Hotel
Knoxville, Tennessee, USA**

**Topical Areas (Technical Area Coordinators) for addition or deletion
“Helsinki Discussion List”**

1. **Structural Performance and Mechanistic Understanding of the Effects of Irradiation on Concrete (Y. Le Pape)**
2. **Harvesting and Characterization of Service Irradiated Concrete (M. Ordonez)**
3. Characterization of the Radiation Field in Concrete (tbd)
4. Gamma Irradiation Studies (tbd)
5. Impact on Long Term Operation (tbd)
6. **Accelerated Irradiation Studies of Concrete and Its Components (M. Koleska)**
7. NDE of Irradiated Concrete: Comments: Clayton
8. Development of Sub-Sized Specimens for Mechanical Testing of Irradiated Concrete (tbd)
9. Irradiated Assisted Alkali Silica Reaction (Coordinated Activity with RILEM): (tbd, Le Pape)
10. **Microstructural Characterization of Irradiated Concrete (C. Andrade)**
11. Irradiation and Testing Facilities (tbd)

Bold: Initial Topical Area selected by the members as ICIC Technical Areas for the First General Meeting in Knoxville, Fall, 2015.

International Committee on Irradiated Concrete (ICIC) First General Meeting ATTENDEES
2 – 5 November 2015
Hilton Hotel
Knoxville, Tennessee, USA

Surname	First Name	Institution	Country
Rosseel	Thomas	Oak Ridge National Lab (ORNL)	United States
Leonard	Keith	Oak Ridge National Lab (ORNL)	United States
Wall	James	EPRI	United States
Ferreira	Miguel	VTT Technical Research Centre of Finland	Finland
Sircar	Madhumita	U.S. NRC	United States
Giorla	Alain	Oak Ridge National Lab (ORNL)	United States
Le Pape	Yann	Oak Ridge National Lab (ORNL)	United States
Burke	John	US NRC	United States
Sant	Gaurav	UCLA	United States
Clayton	Dwight	Oak Ridge National Lab (ORNL)	United States
Bouniol	Pascal	CEA (Atomic Energy Commission)	France
Kontani	Osamu	Kajima Corporation	Japan
Ishikawa	Shunsuke	Kajima Corporation	Japan
Hansen	Jørn-Harald	Institute for Energy Technology	Norway
Neithalath	Narayanan	Arizona State University	United States
Maruyama	Ippei	Nagoya University	Japan

Surname	First Name	Institution	Country
Takizawa	Masayuki	Mitsubishi Research Institute, Inc	Japan
Bary	Benoit	CEA	France
Vaitova	Michaela	Czech Technical University in Prague	Czech Republic
Stemberk	Petr	Czech Technical University in Prague	Czech Republic
Kohoutkova	Alena	Czech Technical University in Prague	Czech Republic
WADA	HIROYUKI	CHUBU ELECTRIC POWER CO., Inc.	Japan
Cernousek	Tomas	Centrum výzkumu; Rez (Research Center, Rez)	Czech Republic
Brabec	Petr	UJV Rez, a. s.	Czech Republic
Ordonez	Manuel	ENRESA	Spain
Korhonen	Ritva	Fortum	Finland
Field	Kevin	Oak Ridge National Lab (ORNL)	USA
Remec	Igor	Oak Ridge National Lab (ORNL)	USA
Anovitz	Lawrence	Oak Ridge National Lab (ORNL)	USA
Busby	Jeremy	Oak Ridge National Lab (ORNL)	USA
Pignatelli	Isabella	UCLA	USA
Pomaro	Beatrice	University of Padova	Italy

ICIC FGM**Meeting Support Participants**

Surname	First Name	Institution	Country
Ross	Lindsey	ORNL / Meeting Support	USA
Strange	Ann	ORNL / Meeting Support	USA
Campbell	Anne	ORNL / LAMDA Tour	USA
Edmondson	Phil	ORNL / LAMDA Tour	USA
Parish	Chad	ORNL / LAMDA Tour	USA
Koyanagi	Takaaki	ORNL / LAMDA Tour	USA
Renfro	David	ORNL / HFIR Tour	USA
Siefkin	Bruce	ORNL / HFIR Tour	USA

**THE CHARTER FOR THE
INTERNATIONAL COMMITTEE ON IRRADIATED CONCRETE (ICIC) / (IC)²
IN NUCLEAR APPLICATIONS
Accepted and Approved, 10 October 2014**

1.0 PURPOSE

The general objective of the **International Committee on Irradiated Concrete (ICIC)** is to provide a forum for broad technical interactions in research on the effects of irradiation on concrete used in nuclear applications, such as nuclear facilities, storage, and disposal sites, and which will contribute to advancing the current state of knowledge.

Specific objectives are to:

1. Provide a forum for timely, informal information exchanges among members and organizations pursuing the identification, quantification, and modeling of the effects of radiation on concrete in commercial nuclear applications. Specifically, determinations of the effects of radiation damage as reflected by changes in engineering properties and their application to concrete are included.
2. Promote broad application of highly specialized or unique investigation techniques to relevant research materials of wide interest to develop improved understanding and predictions of the effects of radiation on concrete, cementitious composites, and its constituents.
3. Facilitate the conception, planning and guidance of new cooperative research programs, for example, by:
 - 1) Facilitating the collection (harvesting) and distribution of pedigreed materials suitable for concrete irradiation damage investigations and non-destructive testing (NDT).
 - 2) Promoting cross-institutional utilization of resources, where possible, which reflect mutual research interests or needs.
 - 3) Promoting and coordinating research on special problems.
4. Promote the transfer of research results to general codes and standards for the evaluation of engineering property changes. .
5. To achieve these goals and objectives, symposia or workshops should be held to promote the dissemination of advances in understanding the effects of radiation on concrete and related materials.

2.0 STRUCTURE:

2.1 Membership Requirements, Obligations, and Rights

- 2.1.1 **Organizational Membership** in the ICIC is restricted to those organizations that are currently performing, managing, and / or funding research and development efforts relevant to the objectives of the ICIC.

Each Organizational Member designates a Principal Contact and agrees to make every reasonable effort to ensure that the Principal Contact or a designated alternate attends each ICIC meeting. Principal Contacts of Organizational Members have the right to recommend and approve appointments to the Executive Committee and changes to the Charter.

Principal Contacts are responsible for ensuring that members of their organizations and their invitees to meetings (see Section 2.1.5) abide by the requirements of the Charter, in particular regarding dissemination of information (Section 3.0).

- 2.1.2 **Individual Members** (this term includes Principal Contacts and members of the Executive Committee) in the ICIC must be employed by an Organizational Member and be actively involved in research and / or facilitating or supporting research relevant to the objectives of the ICIC. As appropriate, the views of those Individual Members present at ICIC meetings on matters regarding the general operation of the ICIC will be gauged by show of hands.
- 2.1.3 **Processing of applications for Membership.** New applications for membership and/or member nominations for a new Principal Contact will be sent to the Secretary. The application should include evidence that the membership requirements of Section 2.1.2 and, for a new organization, Section 2.1.1 can be met. In the case of a new Individual Member this may consist of a brief resume and list of relevant publications, reports, or activities. The Secretary then distributes copies of the applications to the Executive Committee for review. Two procedures are available for membership review and approval: (1) Each Executive Committee member sends a written (electronic) recommendation for approval (or disapproval) to the Secretary within 30 days after its receipt, and the application is approved if supported by at least 3/4 of the Executive Committee; (2) Membership application may be made and approved during a meeting of the Executive Committee. All applications will be acted upon fully within 2 months.
- 2.1.4 **Obligation to attend the General Meetings.** If an Organizational Member is not represented at two successive ICIC General Meetings, its membership will cease pending Executive Committee review. Normal membership application may be required before further participation is possible.
- 2.1.5 **Participation in General Meetings.** Participation in General Meetings is normally limited to those members who are contributing information as an author or co-author of a presentation to be given at the meeting. With the approval of a majority of the Executive Committee Officers, this requirement may be waived. Moreover, with the approval of the Officers, a Principal Contact or a Member of the Executive Committee may invite someone to participate in a meeting without applying for membership, provided that the invited

participant makes a presentation and agrees to abide by the ICIC rules regarding confidentiality and dissemination of information (Section 3.0). Each presenter is required to provide a complete electronic copy of the presentation to the organizing committee for the meeting record (see 3.0). In special circumstances, a Principal Contact may request a non-member attend without presentation, which also must be approved by the Officers. In this case, an attendee will not be given copies of the presentations (Sections 3 and 4).

2.2. Organizational Structure

- 2.2.1 Executive Committee.** The ICIC Executive Committee consists of three Officers (a Chairperson, a Vice-Chairperson, and a Secretary), the Technical Area Coordinators, and immediate past ICIC Chairperson.
- 2.2.1.1 Duties of the Executive Committee** include setting the general theme for each meeting (including decisions regarding special plenary presentations, workshops, etc.), selecting the date, location, and local host for each meeting based upon proposals received from any member, arranging the ICIC General Meetings, preparing meeting agendas, facilitating memberships.
- 2.2.1.2 The Chairperson** serves for one General Meeting, which can be renewed for a second General Meeting by vote of the Principal Contacts.. After serving that period, he or she will be succeeded by the Vice-Chairperson.
- 2.2.1.3 The Vice-Chairperson** will assist the Chairperson as requested and will serve in the absence of the Chairperson.
- 2.2.1.4 The Secretary** will assist the Chairperson and Vice-Chairperson as requested, will prepare a draft agenda for each Executive Committee meeting, will record minutes of each Executive Committee Meeting, and will accomplish other tasks as delineated in various sections of this charter.
- 2.2.2 Technical Area Coordinators (TACs).** Specific technical areas (TA) (research / engineering / technical) may be identified by the Executive Committee to facilitate advances in the area of irradiated concrete. For each TA, a TAC shall be nominated by the EC for approval by vote of Principal Contacts (see 2.2.3). There is no explicit term of service for TACs. A main function of a TAC is to facilitate and expedite progress by the membership in a specified technical area. The TAC also arranges that portion of the General Meeting dealing with his or her activity area and is responsible for a written summary of any issues, accomplishments identified by the presentations, and subsequent discussions.
- 2.2.3 Appointment of Executive Committee Members, Officers, and TACs.** When an opening for an Officer arises, the Chairperson will seek suggestions for nominees from Principal Contacts and members of the Executive Committee. He or she will then draw up a short list of candidates in consultation with other Executive Committee members. Criteria for including candidates will include their suitability for the position, including their future availability and willingness to stand, and the need to maintain a balance of membership on the committee that represents the general membership. The Secretary, or in his or her

absence the Chairperson, will send the list to Executive Committee members each of whom may cast as many votes as there are positions. Votes cast more than 30 days following distribution of the list will be void. The candidate receiving the most votes will receive the appointment. In the event of a tie, the Chairperson will have an additional casting vote.

When an opening for a TAC arises, the procedure will be as that for an Officer, except that Principal Contacts as well as the Executive Committee members will be entitled to vote. Voting will normally be by email to the address last notified to the Secretary.

The immediate past ICIC Chairperson is appointed as an Executive Committee member when his/het term as an officer ends.

Removal of an Executive Committee Member: If a member of the Executive Committee behaves in an inappropriate or unethical manner, is incapacitated and unable to participate in the ICIC, or is no longer working in an irradiated concrete related field, the Secretary will be authorized by the Officers to inform the member and entire Executive Committee of the offense and the intent to hold a vote of removal within 45 days of the notification as well as the right of the member to contend the charges within 45 days of the notification. The decision to remove an Executive Committee member for a specified cause will be made by a majority of those casting votes.

3.0 DISSEMINATION OF INFORMATION:

3.1. Information specifically developed or contributed by a Member or invited non-member:

Information specifically developed or contributed by a member (or invited non-member presenter as described in section 2.1.5) will not be disseminated, formally or informally, to outside bodies or individuals without the specific and explicit approval of the contributor and notification of the Executive Committee. Such information may be disseminated to non-members within an Organizational Member, but the Principal Contact must ensure that it is not disseminated further. Moreover, information discussed and disseminated at the ICIC General meetings shall be focused on technical issues intended to advance research on the effects of radiation on concrete used in nuclear applications. It should not include commercially or business sensitive information or other information that could be considered sensitive from the competition law point of view.

The proceedings of the General Meeting will consist of electronic copies of presentations and discussion summaries (prepared by the TACs) and shall be provided to all members and to all non-member presenters.

The proceedings will not be given to non-member, non-presenting attendees. Any material or information deemed to be of a restricted nature will be so identified by the contributor in advance and will not be included in the meeting record.(Section 2.1.5).

The Secretary will prepare minutes of the Executive Committee meeting for distribution to each Executive Committee member.

3.2. Information Developed by a Coordinated Activity of the ICIC

Information developed through a Coordinated Activity of the ICIC (see Section 1.0 Objectives) will be provided to all participants of the Coordinated Activity in cooperation with co-sponsoring technical or educational organizations.

3.3. Distribution of published / public information

The secretary will maintain a distribution list of where members may submit published materials to disseminate to members of ICIC. This list will be established to allow previously restricted information, which becomes public, to reach members in a timely fashion.

3.4. Website for information

As appropriate, the secretary and executive committee will establish a dedicated website with both public and private (restricted) access depending on the nature of the information.

3.5. Misuse of information

If a member believes that another member or guest misused information presented at an ICIC meeting, that member should notify the Executive Committee in writing of his or her concerns.

The Executive Committee must inform the person accused of misuse and provide at least 45 days for the accused person to respond in writing to the charges. The Executive Committee may request input from other members and outside technical experts as part of the process of gathering information. The Executive Committee will review the information provided by the member filing a complaint, any response by the person accused, and any additional information gathered by the committee and make a determination as to whether misuse occurred and what if any sanctions should be imposed on the person responsible, and possibly on the Principal Contact, with 120 days of receiving the complaint.

Determinations and sanctions may include:

- Acquittal of the charges
- Request for additional information
- Letter of Reprimand and request for apology to Membership
- Suspension of membership in the ICIC
- Termination of membership in the ICIC
- Requesting that the Organizational Member replace its Principal Contact

4.0 MEETINGS

General Meetings of the ICIC will be held at intervals of approximately every 12 – 18 months. The language of the meetings will be English.

At each General Meeting, the Executive Committee will recommend the dates and location for the subsequent General Meeting to the members.

Each General Meeting will last approximately two (2) - three (3) days, one (1) – two (2) days of which typically will be devoted to technical discussions/presentations in workshop format and one (1) to two (2) days devoted to open presentations.

Attendance at the open session will be by member invitation (with advanced notification to the Executive Committee) and may include interested technical experts, researchers, managers, or sponsors.

Attendance in the “technical workshop” will include ICIC members and individuals who have unique or specialized information applicable to irradiated concrete research. The Technical Area Coordinators, in coordination of the Executive Committee, will invite these individuals provided that the invited participant makes a presentation and agrees to abide by the ICIC rules regarding confidentiality and dissemination of information (Section 3). Each presenter is required to provide a complete electronic copy of the presentation to the organizing committee for the meeting record (Section 3). In special circumstances, a Principal Contact may request a non-member attend without presentation, which also must be approved by the Officers. In this case, an attendee will not be given copies of the presentations. (Section 2.1.5)

A meeting of the Executive Committee will normally precede each General Meeting. Additional meetings of the Executive Committee and the various Task Groups will be held on an as-needed basis.

5.0 CHANGES TO CHARTER

The Officers will be responsible for ensuring that the requirements of the Charter are met, while the Secretary will be responsible for drafting amendments to the Charter to meet the changing requirements of the ICIC.

Any member may recommend changes to the Charter. The Secretary will send proposed Amendments to the Charter to Principal Contacts for a vote within 30 days of a formal proposal.

The voting will be by e mail and will be adopted if over 2/3 of those Principal Contacts who respond within 45 days of the email being sent are in favor. Failure to respond will be assumed to be an abstention. The Secretary will notify all members of the outcome and distribute, if an amendment has been adopted, a revised Charter to all members within 45 days of adoption of the amendment.

ADDENDUM

Resource Sharing / Leveraging:

- Service Irradiated Concrete Cores
- Characterization of harvested cores
- Pre-Irradiation Evaluation Characterization.
- Post Irradiation Evaluation Characterization
- Round Robin Testing
- Establishing Characterization Protocols
- Modeling and Damage Mechanisms.

ESTABLISHING CHARACTERIZATION PROTOCOLS:

- Mechanical Testing (compressive strength, elastic modulus, etc.)
- Phase composition (with XRD)
- Microstructure (TEM/SEM/ Optical Microscopy)
- Porosity (Total)
- Dimensional changes (resolution)
- Mass (changes)
- DTA (water, portlandite, and carbonate content)
- Hardness (nano indenter)
- Sorption balance
- Pore size
- NDE

COORDINATED RESEARCH ON SPECIAL PROBLEMS:

- IAEA CRP
- RILEM
- ASTM